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Office of Intellectual Property Counsel
3M Innovative Properties Company
PO Box 33427
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PATENT

Docket No.
53714USA6B

Transmittal of Continuing Patent Application - Rule 1.53(b)

Box: Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Anticipated Classification

Pursuant to 37 CFR 1.53(b), please file a

- ☐ continuation
- ☒ continuation-in-part
- ☐ divisional

application of pending prior Application No. 08/957,573, filed on October 24, 1997.

Inventor(s): David J. Lundin

Title: LIGHT GUIDE ILLUMINATION DEVICE APPEARING UNIFORM IN BRIGHTNESS ALONG ITS LENGTH

1. ☐ Enclosed is a copy of the oath or declaration filed in the prior application.
2. ☒ Enclosed is a newly executed oath or declaration.
3. ☐ Enclosed is a copy of the specification as filed in the prior application.
4. ☒ Enclosed is a new specification.
5. ☒ Enclosed are 1 sheet(s) of drawings.
6. ☐ The entire disclosure of the prior application is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein. (not applicable for CIP)
7. ☐ Please amend the specification by inserting before the first line the sentence:
   This is a continuation of Application No. _____ filed _____.
8. ☐ Please cancel claims _____.
9. ☐ A preliminary amendment is enclosed.
10. ☐ This application is being filed by less than all the inventors named in the prior application. Please delete the names of the following person(s) who are not inventors of the invention being claimed in this application: _____

The fee for filing the application is computed as follows:

Claims As Filed, After Accounting For Any Claims Canceled Or Added In Paragraphs 8 Or 9 Above				
(1) For	(2) Number Filed	((3) Number Extra	(4) Rate	(5) Basic Fee $690
Total Claims	18 -20 =	-0-	x $18.	$-0-
Independent Claims	1 -3 =	-0-	x $78.	$-0-
Additional fee for filing one or more multiple dependent claims			$260.	$-0-
		Total Filing Fee Due →		$690.00

11. ☒ Please charge to Deposit Account 13-3723 any fees under 37 CFR 1.16 and 1.17 which may be required to file and during the entire pendency of this application. This authorization includes the fee for any extension of time under 37 CFR 1.136(a) that may be necessary. To the extent any such extension should become necessary it is hereby requested. A copy of this transmittal letter for fee processing is enclosed.

12. An assignment
    - ☐ to 3M Innovative Properties Company is of record in the prior application.
    - ☐ from Minnesota Mining and Manufacturing Company to 3M Innovative Properties Company has been filed/is being filed concurrently in the prior application but is not yet recorded.
    - ☒ to 3M Innovative Properties Company is enclosed along with a completed Assignment Recordation Cover Sheet.

13. ☐ A power of attorney is enclosed.

14. ☒ Enclosed is a return receipt postcard.

15. ☐ Other

Respectfully submitted,

Registration Number	Telephone Number
30,035	(651) 733-3379
Date	
01/07/00	

Signature

Print Name

Stephen W. Buckingham

Certificate of Express Mailing

Pursuant to 37 CFR 1.10 I certify that this application is being deposited on the date indicated below with the United States Postal Service "Express Mail Post Office to Addressee" service addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

Express Mail Mailing Label No.	Signature of Person Mailing Application
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Date of Deposit	**Printed Name of Person Mailing Application**
01/07/00	**Debra J. Carson**

LIGHT GUIDE ILLUMINATION DEVICE APPEARING UNIFORM IN BRIGHTNESS ALONG ITS LENGTH

RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Appl. Serial No. 08/957573 entitled "Articles With Diffuse Reflection of Light From Light Fibers," filed in the U.S. Patent Trademark Office on October 24, 1997.

FIELD OF THE INVENTION

The present invention relates generally to an illumination device, and more particularly, to a light guide illumination device having optical quality light extraction structures and a diffuse reflective material to provide a light guide that appears substantially uniform in brightness along its length.

BACKGROUND OF THE INVENTION

Optically transmissive materials, such as glass or polymers may be used as a light guide to propagate light. A light guide typically includes at least one surface adapted to receive light from a light source and an optically smooth surface for reflecting light propagating through the light guide. Common examples of light guides include optical fibers traditionally used in the data communication industry and more recently light fibers used for illumination purposes. For example, U.S. Patent No. 5,432,876 (the '876 patent) discloses one such illumination device employing light fibers. In this device, light may be injected into at least one end of a light fiber and allowed to exit the fiber at a predetermined position or positions along the length of the fiber. Light extraction structures or notches are formed in the core of the light fiber. The extraction structures define first and second reflecting surfaces, which reflect in a radial direction a portion

of the light propagating axially through the fiber. The reflected light is directed at an angle that is less than the critical angle necessary for continued propagation along the fiber according to the principle of total internal reflection. As a result, the reflected light is extracted from the fiber. In contrast to prior techniques such as subjecting the fiber to relatively sharp bends, this system extracts light from the fiber in a controlled fashion.

Because the previously mentioned light extraction structures are formed from optically smooth surfaces, they reflect light by total internal reflection rather than by diffuse reflection. As a result, light is emitted from the light fiber in a pattern dictated by the configuration and arrangement of the extraction structures along the fiber. In general, when viewed at relatively close proximity, light from individual light extraction structures appears as discrete lines of light. That is, the light fiber generally will not appear to produce even illumination along its length, as does, for example, a fluorescent light. For example, when the extraction structures are sufficiently far apart from one another, the illumination pattern generated along the fiber is a series of bright stripes or lines of light alternating with regions of reduced intensity. In other cases, notably in planar light guides used to provide flat panel illumination, an image of the light source is transferred down the light guide so that the resulting illumination pattern includes an image of the light source, thus creating a nonuniform brightness level across the surface of the light guide.

A light fiber that appears uniform in brightness along its length is desirable for many applications. For example, such a light fiber could be used in place of neon lighting, which is often employed to form self-illuminated characters or letters or to outline the profile of a portion of a building..

U.S. Appl. Serial No. 08/957573 discloses a light fiber illumination device that employs roughened or uneven areas on the interior of the cladding, which serve as light extraction structures. The roughened areas comprise randomly dimensioned protrusions or pits that extract light in a diffuse manner. Because the extracted light is diffuse, it appears more uniform in brightness along the length of the fiber than the light extracted by extraction structures formed from optically smooth surfaces.

Unfortunately, because the roughened areas are not of optical quality but are rather random in size and orientation, it is difficult to control the amount of light radially extracted from the fiber and thus in general it is difficult to achieve high levels of brightness by this extraction technique. Thus, while such roughened areas facilitate the diffusion of light, they are less efficient at extracting the light than light extraction structures formed from optical quality surfaces.

To overcome the problem of reduced brightness, the previously mentioned patent application employs a diffuse reflective sheet of material that is disposed around a portion of the light fiber. The diffuse reflective sheet is used to reflect light back through the fiber at angles such that most of the reflected light passes through the fiber. Light that would otherwise be extracted and transmitted away from a viewer can then be observed, adding brightness to light extracted from an observable portion of the fiber. In essence then, this light fiber illumination device uses the diffuse reflective sheet primarily to increase the apparent amount of light that is extracted, while the roughened portions of the cladding are used to extract as well as diffuse the emitted light

However, since they are more efficient at extracting light, it would be advantageous to use optical quality light extraction structures rather than roughened portions of the cladding to extract light from the fiber. Unfortunately, a device using such an extraction technique typically appears to have discrete, non-uniform areas of brightness along its length.

The present invention is therefore directed to the problem of providing an illumination device that extracts light in a relatively efficient manner to enhance its brightness while producing even or uniform illumination along its length.

SUMMARY OF THE INVENTION

The present invention solves this problem by employing optical quality extraction structures for performing light extraction and a diffuse reflective layer for diffusely reflecting the extracted light. Thus, the most efficient element is employed for extracting light while the most appropriate element, a diffuse reflective layer, is reserved for diffusely reflecting light.

The present invention provides an illumination device that includes a light guide including a light guide core having an optically smooth surface for propagating light therethrough. A light emitting region, which extends along a portion of the core, includes at least one light extraction structure located along the optically smooth surface of the light guide core. The light extraction structure, which includes an optically reflective surface extending into the light guide core, is oriented to reflect light at an angle less than a critical angle necessary for light to propagate through the light guide core. A diffuse reflective sheet material is disposed around at least a portion of the light guide. The diffuse reflective material directs at least a portion of the light reflected by the light extraction structure back through the light guide so that the light is emitted through the light emitting region of the optically smooth surface.

In accordance with one aspect of the invention, the light guide may be a light fiber. Additionally, the light guide may have a circular or noncircular cross-sectional shape, and may even be a planar waveguide.

In accordance with yet another aspect of the invention, the diffuse reflective sheet material is a polymeric sheet material. Alternatively, the diffuse reflective sheet material may be microvoided sheet material, a microporous material such as polytetrafluoroethylene, or a material formed by thermally induced phase separation.

In accordance with another aspect, the illumination device includes a plurality of light extraction structures, The extraction structures may be equally spaced apart from one another along the optically smooth surface. Alternatively, the plurality of light extraction structures may be unequally spaced apart from one another along the optically smooth surface.

In one particularly advantageous embodiment, the light guide is formed from a polymerizable material such as an acrylate or urethane material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a schematic, cross-sectional view of a known illumination device illustrating the operation of the light extraction structures.

FIG 2 is a schematic, cross-sectional view of an illumination device constructed in accordance with the present invention.

FIG 3 is a schematic, cross-sectional view of an alternative embodiment of the invention that employs a cladding material.

DETAILED DESCRIPTION

Light Guide Illumination Device

FIG 1 depicts a side view of a portion of a known illumination device. The illumination device is formed from a light guide 130 having a light guide core and a cladding surrounding the core. The refractive index of the core is greater than the refractive index of the cladding so that the light traveling through or along or down the light guide is reflected at the surfaces of the light guide with minimal losses in accordance with the principles of total internal reflection. In the simplest case, the cladding may be ambient air, thus avoiding the need for a separate cladding material. The illumination device shown in FIG. 1 does not employ a cladding material.

Light guide 130 has a circumferential surface 116 that includes one or more light extraction structures 118_1, 118_2, 118_3, ... that are formed therein. Circumferential surface 116 includes a first surface portion 131, which contain light extraction structures 118_1, 118_2, 118_3, ..., and a second surface portion 132 located diametrically opposite first surface portion 131. Each extraction structure includes at least one optically smooth surface 120_1, 120_2, 120_3, ... In operation, light ray 140 strikes a portion of circumferential surface 116 not occupied by a light extraction structure 118, where it is reflected back into the light guide at an angle greater than the critical angle of the light guide, and accordingly, continues to propagate along the light guide. By contrast, light ray 142 strikes an optically smooth surface 120_1 of light extraction structure 118_1, which reflects light ray 142 into light guide 130 at an angle which is less than the critical angle necessary for continued propagation along light guide 130. Light ray 142 is thereby transmitted through the second surface portion 132 of circumferential surface 116. As previously mentioned, while the illumination device depicted in FIG. 1 is relatively efficient at extracting light, the light is not diffuse and thus may not appear uniform along the length of the fiber.

FIG. 2 shows an embodiment of an illumination device 230 constructed in accordance with the present invention. The device is similar to the illumination device shown in FIG. 1 except that a diffuse reflective layer 250 is provided along second surface portion 232. In other words, diffuse reflective layer 250 is positioned to interrupt the path of light ray 42 shown in FIG. 1. As a result, rather than being emitted from the light guide, light ray 42 is now diffusely reflected back into light guide core 260. As shown in FIG. 2, light ray 242 now strikes the first surface portion 231 of circumferential surface 216 at an angle less than the critical angle necessary for continued propagation along light guide 230 and thus the light is transmitted through first surface portion 231. Accordingly, in contrast to the known illumination light guide depicted in FIG. 1, light is now emitted from the inventive illumination device through the portion 231 of circumferential surface 216 in which light extraction structures 218_1, 218_2, 218_3, ... are located.

One important advantage of the present invention is that light is extracted from the light guide in a controlled and efficient manner, yet the light guide appears uniform in brightness without inhomogeneities caused, for example, by the spacing of the extraction structures.

Diffuse reflective layer 250 may be in direct contact with the core of light guide 230. As a result of the direct contact, however, some light may be extracted by reflective layer 250. Alternatively, to prevent light extraction by diffuse reflective layer 250, in preferred embodiments of the invention such as shown in FIG. 3, a cladding 255 may be interposed between the core and diffuse reflective layer 250. In FIGS. 2 and 3 like elements are denoted by like reference numerals.

Diffuse reflective layer 250 may be formed from microvoided particle-filled sheets that are diffusely reflective due to differences in refractive index of the particles, the surrounding matrix, and air-filled voids created or enlarged by, for example, stretching. In addition, microporous materials made from, for example, sintered polytetrafluoroethylene (PTFE), made in sheet form, can also act as diffuse reflective material. Another particularly suitable diffuse reflective sheet material comprises a microporous polyolefin material often referred to as a TIPS (thermally induced phase separation) sheet material. Examples of such materials are described in

U.S. Patent Nos. 4,539,251, 4,726,989, and 4,867,881. TIPS sheet material typically includes a thermoplastic polymeric structure having a plurality of cells with adjacent cells being interconnected by passageways to provide a network of communicating pores. This sheet material is oriented in at least one direction. The thermoplastic polymeric structure may be substantially homogeneous or the porosity of the structure may exhibit a gradient therethrough. The cells typically include void spaces encased by fibrous, lacy, or semi-continuous boundaries.

While in a preferred embodiment of the invention light guide 230 shown in FIG. 2 is formed from a light fiber, it should be recognized that the present invention is not limited to light fibers but rather is applicable to any form of light guide. Moreover, the light guides need not have a circular cross-section, but rather may have any desired shape. For example, in some embodiments the present invention contemplates the use of planar waveguides.

The present invention encompasses light guides having optical quality light extraction structures which are configured and distributed along the light guide. In particular, the size and spacing of the light extraction structures need not be uniform. For example, in some embodiments of the invention it may be advantageous to increase the density of light extraction structures at locations increasingly distant along the longitudinal axis of the light guide. Such an arrangement can improve the uniformity in the brightness of the light emitted along the longitudinal axis because the greatest amount of light in the light fiber is available for extraction immediately adjacent to the light source. Diminishing amounts of light are available further down the core because light has already been extracted. By increasing the density of light extraction structures (i.e., the total surface area of the light extraction structures per unit surface area of fiber) at increasing distances from the light source, the least amount of light extraction takes place closest to the light source and the greatest amount takes place farthest away from the source.

A reflector 243 may be incorporated at the end of light guide 230 that is remote from the light source. Any light that is not emitted by one of the light extraction structures 218_1, 218_2, 218_3, ... upon its initial pass through the light guide will be reflected so that it has another opportunity to be emitted by a light extraction structure. In this way a greater portion of the total

light directed into light guide 230 is used for illumination purposes. Instead of reflector 243, light sources may be provided at both ends of the light guide. In this case the density of light extraction structures is preferably greatest at the middle of the light guide and decreases toward both light guide ends, assuming both light sources are equal in intensity.

It should be noted that the illumination device of the present invention is not limited to a light guide that extends linearly. More generally, the light guide may have any shape that is desired for a given application. For example, if the illumination device is to be used in place of neon lighting, the light guide may be constructed to at least partially resemble a letter, numeral, or other symbol.

Light Guide Illumination Device Fabrication

The illumination device of the present invention may be fabricated by any desired technique. In one method the light extraction structures are directly micro-machined into the light guide itself. In another method, a molding process is employed, which uses a conventional mold such as a two piece mold. Alternatively, the mold may be an expandable mold of the type disclosed in U.S. Application Serial No. 09/026,836, entitled "Method and Apparatus for Seamless Microreplication Using an Expandable Mold." Briefly, an expandable mold is formed from a flexible material having a generally hollow portion that corresponds to the shape of the desired finished article (i.e., the light guide). The hollow portion is accessible through at least one opening. The hollow portion is filled with a curable material that hardens in the shape of the hollow portion of the mold. Once hardened, the finished article is removed by applying a pressure differential between the inside and outside of the mold so that the walls of the mold distend to facilitate removal of the molded article. Additional details concerning the expandable mold may be found in the previously mentioned patent application, which is hereby incorporated by reference in its entirety including the drawings, as if repeated herein.

Regardless of the type of mold that is employed, the curable material that forms the finished article may be any material that hardens into a substantially optically transparent

material and which can be introduced into the mold and hardened at temperatures and/or pressure conditions that do adversely affect the mold. The curable material may be curable by heat, radiation, or other known processes. Suitable curable materials include a polymerizable compound or mixture. Acrylates are a class of curable materials that are preferable for their transparency properties. Urethanes are also a desirable class of curable materials because their contraction during curing tends to be minimal, although only certain formulations have desirable transparency properties. Yet another curable material that may be used is silicone.

Other techniques also may be used in the fabrication of the illumination device of the present invention. For example, U.S. Patent No. 5,631,994 is directed to a method in which an overlay is provided that incorporates the extraction structures. The overlay, which is formed from an optically transparent substrate, is fabricated by conventional manufacturing processes, such as a molding process. An adhesive backing is applied to the overlay so that it can adhere to the fiber core.

The diffuse reflective layer may be formed on the light guide by any of a variety of means including direct contact and an index matching optical adhesive. Alternatively, the reflective layer can be directly coated onto the light guide in a manner similar to paint. The reflective layer can be provided on the light guide core or cladding, if present.

WHAT IS CLAIMED IS:

1. An illumination device comprising:

a light guide including a light guide core having an optically smooth surface for propagating light therethrough and a light emitting region extending along a portion of the core, the light emitting region including:

at least one light extraction structure located along the optically smooth surface of the light guide core, said light extraction structure including an optically reflective surface extending into the light guide core and oriented to reflect light at an angle less than a critical angle necessary for light to propagate through the light guide core; and

a diffuse reflective material disposed around at least a portion of the light guide to direct at least a portion of the light reflected by the light extraction structure back through the light guide core so that light is emitted through the light emitting region of the optically smooth surface.

2. The device of claim 1 wherein said light guide is a light fiber.

3. The device of claim 1 wherein said light guide has a circular cross-sectional shape.

4. The device of claim 1 wherein said light guide is a planar light guide.

5. The device of claim 1 further comprising a plurality of light extraction structures distributed along the optically smooth surface of the light guide core.

6. The device of claim 5 wherein the plurality of light extraction structures are equally spaced apart from one another along the optically smooth surface.

7. The device of claim 5 wherein the plurality of light extraction structures are unequally spaced apart from one another along the optically smooth surface.

8. The device of claim 1 wherein said light guide is formed from a polymerizable material.

9. The device of claim 8 wherein said polymerizable material is an acrylate material.

10. The device of claim 9 wherein said polymerizable material is a urethane material.

11. The device of claim 1 further comprising a cladding material surrounding the light guide core.

12. The device of claim 11 wherein the diffuse reflective sheet material is disposed around a portion of the cladding.

13. The device of claim 1 wherein the diffuse reflective sheet material comprises a polymeric material.

14. The device of claim 1 wherein the diffuse reflective sheet material comprises a microvoided material.

15. The device of claim 1 wherein the diffuse reflective sheet material is a material formed by thermally induced phase separation.

16. The device of claim 1 wherein the diffuse reflective material comprises a microporous material.

17. The device of claim 16 wherein the microporous material comprises polytetrafluoroethylene.

18. The device of claim 1 wherein the light guide is constructed in the form of a predetermined shape to at least partially resemble a letter numeral, or symbol.

ABSTRACT

An illumination device that is relatively bright and uniform in appearance includes a light guide, which has a light guide core having an optically smooth surface for propagating light therethrough. A light emitting region, which extends along a portion of the core, includes at least one light extraction structure located along the optically smooth surface of the light guide core. The light extraction structure, which includes an optically reflective surface extending into the light guide core, is oriented to reflect light at an angle less than a critical angle necessary for light to propagate through the light guide core. A diffuse reflective material is disposed around at least a portion of the light guide. The diffuse reflective material directs at least a portion of the light reflected by the light extraction structure back through the light guide so that light is emitted through the light emitting region of the optically smooth surface.

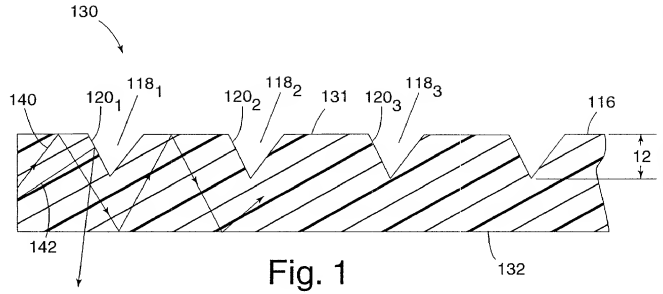

Fig. 1

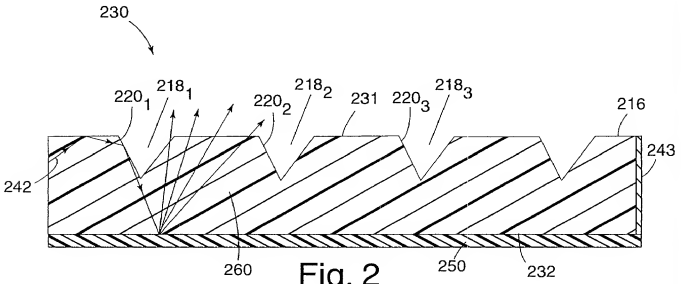

Fig. 2

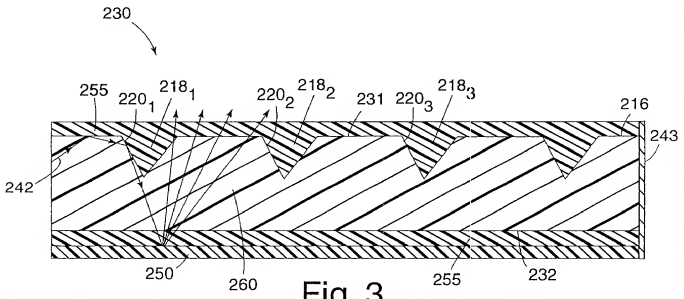

Fig. 3

DECLARATION, POWER OF ATTORNEY, AND PETITION

I, a below named inventor, depose and say that: (1) my residence, citizenship, and mailing address are indicated below; (2) I have reviewed and understand the contents of attached specification, including the claims, as amended by any amendment specifically referred to herein, (3) I believe that I am the original, first, and sole inventor or discoverer of the invention or discovery in

LIGHT GUIDE ILLUMINATION DEVICE APPEARING UNIFORM IN BRIGHTNESS ALONG ITS LENGTH

described and claimed therein and for which a patent is sought; and (4) this application in part discloses and claims subject matter disclosed in my earlier filed patent application, Serial No. filed , and claims priority to that application; (5) I hereby acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to the patentability as defined in Title 37, Code of Federal Regulations, §1.56.*; and (6) I hereby acknowledge my duty to disclose to the Patent and Trademark Office material information as defined in Title 37, Code of Federal Regulations, §1.56.* which occurred between the filing date of said earlier application and the filing date of this application.

No application for patent or inventor's certificate on said common or said non-common subject matter has been filed by me or my representatives or assigned in any country foreign to the United States of America, except as follows: .

I hereby appoint Gregory D. Allen (Reg. No. 35,048), Scott A. Bardell (Reg. No. 39,594), Carolyn A. Bates (Reg. No. 27,853), Stephen W. Bauer (Reg. No. 32,192), Dale A. Bjorkman (Reg. No. 33,084), Jennie G. Boeder (Reg. No. 28,952), William J. Bond (Reg. No. 32,400), Stephen W. Buckingham (Reg. No. 30,035), John A. Burtis (Reg. No. 39,924), Paul W. Busse (Reg. No. 32,403), Gerald F. Chernivec (Reg. No. 26,537), James D. Christoff (Reg. No. 31,492), Philip Y. Dahl (Reg. No. 36,115), Charles L. Dennis II (Reg. No. 30,555), Janice L. Dowdall (Reg. No. 31,201), Lisa M. Fagan (Reg. No. 40,601), Darla P. Fonseca (Reg. No. 31,783), John A. Fortkort (Reg. No. 38,454), Melanie G. Gover (Reg. No. 41,793), Gary L. Griswold (Reg. No. 25,396), Doreen S. L. Gwin (Reg. No. 35,580), Michaele A. Hakamaki (Reg. No. 40,011), Karl G. Hanson (Reg. No. 32,900), Néstor F. Ho (Reg. No. 39,460), Jeffrey J. Hohenshell (Reg. No. 34,109), Robert W. Hoke (Reg. No. 29,226), Arlene L. Hornilla (Reg. No. P-44,776), MarySusan Howard (Reg. No. 38,729), Stephen C. Jensen (Reg. No. 35,207), Robert H. Jordan (Reg. No. 31,973), Harold C. Knecht III (Reg. No. 35,576), Kent S. Kokko (Reg. No. 33,931), Charles D. Levine (Reg. No. 32,477), Douglas B. Little (Reg. No. 28,439), Eloise J. Maki (Reg. No. 33,418), Lisa M. McGeehan (Reg. No. 41,185), Matthew B. McNutt (Reg. No. 39,766), Michelle M. Michel (Reg. No. 33,968), William D. Miller (Reg. No. 37,988), Peter L. Olson (Reg. No. 35,308), Daniel R. Pastirik (Reg. No. 33,025), David B. Patchett (Reg. No. 39,326), Robert J. Pechman (Reg. No. 45,002), Carolyn V. Peters (Reg. No. 33,271), Scott R. Pribnow (Reg. No. 43,869), Ted K. Ringsred (Reg. No. 35,658), James A. Rogers (Reg. No. 37,228), Steven E. Skolnick (Reg. No. 33,789), Robert W. Sprague (Reg. No. 30,497), Brian E. Szymanski (Reg. No. 39,523), Yen Tong-Florczak (Reg. No. 45,163), James J. Trussell (Reg. No. 37,251), and Lucy C. Weiss (Reg. No. 32,834), Stuart Mayer (Reg. No. 35,277) my attorneys and/or agents with full powers (including the powers of appointment, substitution, and revocation) to prosecute this application and any division, continuation, continuation-in-part, reexamination, or reissue thereof, and to transact all business in the Patent and Trademark Office connected therewith; the mailing address and the telephone number of the above-mentioned attorneys and/or agents are

Attention: Stephen W. Buckingham
Office of Intellectual Property Counsel
3M Innovative Properties Company
P.O. Box 33427
St. Paul, Minnesota 55133-3427
Telephone No. (651) 733-3379

The undersigned petitioner declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

*Title 37, Code of Federal Regulations, §1.56 is attached.
This form may be executed only when attached to the specification (including claims) as the last page thereof.

Wherefore, I pray for grant of Letters Patent for the invention or discovery described and claimed in the attached specification and I hereby subscribe my name to the foregoing specification and claims, declaration, power of attorney, and this petition, on the day set forth below.

David J. Lundin 1/7/00

David J. Lundin Date

Residence: Woodbury, MN, USA
Citizenship: US
Post Office Address: P.O. Box 33427
St. Paul, Minnesota 55133-3427

§1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.